



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme January 2004

GCE

Mathematics & Statistics B

Unit MBD2

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Key to mark scheme

M	mark is for	method
m	mark is dependent on one or more M marks and is for	method
A	mark is dependent on M or m mark and is for	accuracy
B	mark is independent of M or m marks and is for	method and accuracy
E	mark is for	explanation
√ or ft or F		follow through from previous incorrect result
CAO		correct answer only
AWFW		anything which falls within
AWRT		anything which rounds to
AG		answer given
SC		special case
OE		or equivalent
A2,1		2 or 1 (or 0) accuracy marks
- x EE		Deduct x marks for each error
NMS		No method shown
PI		Perhaps implied
c		Candidate

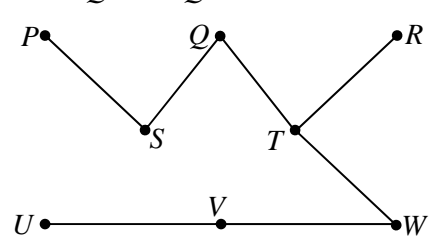
Abbreviations used in marking

MC - x	deducted x marks for miscopy
MR - x	deducted x marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	work replaced by candidate

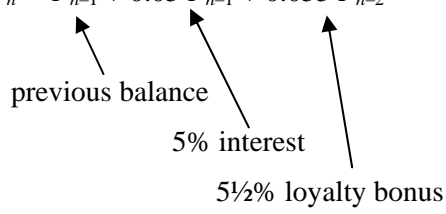
Application of mark scheme

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Question number and part	Solution	Marks	Total	Comments
1(a)	Formula \Rightarrow $u_n = 3 \cdot (0.5)^{n-1} + 1 \cdot ((0.5)^{n-1} - 1) / (0.5 - 1)$ which tidies up to $2 + (0.5)^{n-1}$	M1 A1 A1 A1	4	(or other methods, e.g. $u_n = 3(0.5)^{n-1} + (0.5)^{n-2} + \dots + 1$)
(b)	Tends to 2	B1✓	1	ft
Total			5	
2 (a)	DEED = - . . . - .	M1 A1	2	
(b)	- . . . - . can be read as BED	M1 A1	2	
(c)	e.g. need a third symbol for 'pause'	B1	1	
Total			5	
3(a)(i)	Six odd vertices <i>PRSTUW</i> Pairing them off take at least 3 tracks	B1 B1	2	Just B1 for "odd vertices"
(ii)	Want to pair off <i>PRSTUW</i> to include <i>PS</i> or <i>PU</i> : <i>PS RT UW PU RS TW</i> <i>PS RU TW PU RT SW</i> <i>PS RW TU PU RW ST</i> Repeating <i>PS RT UV/VW</i> takes 4+4+4 and is clearly unbeatable as each joined pair adds at least 4.	M1 A1 A1 M1 A1	5	(or use any sensible short-cuts)
(b)	<i>UV VW QS PS QT RT WT</i> : 23 	M1 A1 M1 A1	4	
(c)(i)	Trainspotter's cycle length \geq $25 + 25 + \text{minimum connector length}$ $= 50 + 23 = 73$	M1 A1		
(ii)	73 not possible because (unique) minimum connector is not a path. Switching <i>QT</i> to <i>QR</i> makes it a path 1 mile longer, giving shortest round route: e.g. Home <i>PSQRTWVU</i> Home	B1 M1 A1	5	
Total			16	

Question number and part	Solution	Marks	Total	Comments
4 (a)	(i) 30 (ii) 25	B1 B1	2	
(b)	YZ = 5 XZ = 0 WX = 5 SW = 15	M1 A1 A1	3	
(c)	SYZT SYWXT	M1 A1 M1 A1	4	
(d)	Total flow in (c) = 15+5+5=25 Max flow \leq any cut, so no flow can exceed the 25 in (a)(ii)	M1 A1	2	
	Total		11	
5 (a)	00000 00101 11110 11011 00011	M1 A1 A1	3	
(b)(i)	Hamming distance $\delta = 2$	M1 A1		
(ii)	1 error will change codeword into non-codeword	B1	3	(or simply " $1 < \delta$ ")
(c)	00111 can be 00101 or 00011 (or 00110) with a single error – impossible to decide which	M1 A1	2	
(d)	e.g. $\begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$	M1 A1	2	(or replace a row by (0 0 1 1 1))
(e)(i)	Hamming distance = 4	M1✓ A1✓		ft 2 \times earlier δ
(ii)	Can correct 1 error per word	B1✓	3	ft
	Total		13	

Question number and part	Solution	Marks	Total	Comments
6 (a)	$P_0 = 460 \quad P_1 = 483$	B1 B1	2	
(b)	$P_n = P_{n-1} + 0.05 P_{n-1} + 0.055 P_{n-2}$  <p>previous balance</p> <p>5% interest</p> <p>5½% loyalty bonus</p>	B1 B1 B1	3	2 marks for starting at $P_n = 1.05 P_{n-1} + 0.055 P_{n-2}$
	Tidies up to $200P_n - 210P_{n-1} - 11P_{n-2} = 0$			
(c)	Auxiliary equation	M1		
	$200m^2 - 210m - 11 = 0$	A1		
	Roots 1.1 and -0.05	M1 A1		
	General solution			
	$P_n = A.(1.1)^n + B.(-0.05)^n$	A1	5	
(d)	$A + B = 460$			
	$1.1A - 0.05B = 483$	M1		
	$\Rightarrow 22A - B = 9660$	A1		
	$\Rightarrow A = 440, B = 20$	M1		
	$\Rightarrow P_n = 440(1.1)^n + 20(-0.05)^n$	A1	4	
	Total		14	

Question number and part	Solution	Marks	Total	Comments																																								
7(a)	Maximise $P = 20x + 10y + 30z$ Subject to $x \geq 0, y \geq 0, z \geq 0, 2x + y + 2z \leq 110$ $x + y + z \leq 60, 2x + 3y + 3z \leq 140$	M1 A1 A1	3																																									
(b)	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="padding-right: 10px;">P</td> <td style="padding-right: 10px;">x</td> <td style="padding-right: 10px;">y</td> <td style="padding-right: 10px;">z</td> <td style="padding-right: 10px;">s</td> <td style="padding-right: 10px;">t</td> <td style="padding-right: 10px;">u</td> <td></td> </tr> <tr> <td>1</td><td>-20</td><td>-10</td><td>-30</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>0</td><td>2</td><td>1</td><td>2</td><td>1</td><td>0</td><td>0</td><td>110</td> </tr> <tr> <td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>60</td> </tr> <tr style="border-top: 1px solid black;"> <td>0</td><td>2</td><td>3</td><td>3</td><td>0</td><td>0</td><td>1</td><td>140</td> </tr> </table>	P	x	y	z	s	t	u		1	-20	-10	-30	0	0	0	0	0	2	1	2	1	0	0	110	0	1	1	1	0	1	0	60	0	2	3	3	0	0	1	140	M1 A1	2	
P	x	y	z	s	t	u																																						
1	-20	-10	-30	0	0	0	0																																					
0	2	1	2	1	0	0	110																																					
0	1	1	1	0	1	0	60																																					
0	2	3	3	0	0	1	140																																					
(c)	<table style="border-collapse: collapse; width: 100%;"> <tr> <td>1</td><td>0</td><td>0</td><td>-10</td><td>10</td><td>0</td><td>0</td><td>1100</td> </tr> <tr> <td>0</td><td>1</td><td>½</td><td>1</td><td>½</td><td>0</td><td>0</td><td>55</td> </tr> <tr> <td>0</td><td>0</td><td>½</td><td>0</td><td>-½</td><td>1</td><td>0</td><td>5</td> </tr> <tr style="border-top: 1px solid black;"> <td>0</td><td>0</td><td>2</td><td>1</td><td>-1</td><td>0</td><td>1</td><td>30</td> </tr> </table>	1	0	0	-10	10	0	0	1100	0	1	½	1	½	0	0	55	0	0	½	0	-½	1	0	5	0	0	2	1	-1	0	1	30	M1 A1 M1 A1 A1	5	Pivot → 1 Subtracting rows								
1	0	0	-10	10	0	0	1100																																					
0	1	½	1	½	0	0	55																																					
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0	0	2	1	-1	0	1	30																																					
(d)	<table style="border-collapse: collapse; width: 100%;"> <tr> <td>1</td><td>0</td><td>20</td><td>0</td><td>0</td><td>0</td><td>10</td><td>1400</td> </tr> <tr> <td>0</td><td>1</td><td>-1½</td><td>0</td><td>1½</td><td>0</td><td>-1</td><td>25</td> </tr> <tr> <td>0</td><td>0</td><td>½</td><td>0</td><td>-½</td><td>1</td><td>0</td><td>5</td> </tr> <tr style="border-top: 1px solid black;"> <td>0</td><td>0</td><td>2</td><td>1</td><td>-1</td><td>0</td><td>1</td><td>30</td> </tr> </table>	1	0	20	0	0	0	10	1400	0	1	-1½	0	1½	0	-1	25	0	0	½	0	-½	1	0	5	0	0	2	1	-1	0	1	30	M1 A1 A1	3									
1	0	20	0	0	0	10	1400																																					
0	1	-1½	0	1½	0	-1	25																																					
0	0	½	0	-½	1	0	5																																					
0	0	2	1	-1	0	1	30																																					
(e)	Make 25 stools, 0 armchairs and 30 settees. Impractical because people want matching armchairs.	M1✓ A1✓ B1	3	ft																																								
	Total		16																																									
	TOTAL		80																																									